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from solution, and there is nothing to indicate that the nuggets have undergone either igneous or hydrothermal fusion.

It is not often that there is an opportunity to determine the changes in a well water extending over a long period of years, but this has been done by W. W. Fisher in the case of the water of the Trafalgar Square well. He prints in a recent number of the *Analyst* an analysis just made of this water, comparing it with analyses made in 1848 and in 1857. These analyses show that the character of the water has not changed essentially, although the quantity of potassium salts has diminished quite decidedly. In this connection the author calls attention to the fact that alkaline waters are drawn not only from the chalk under the London clay, but also from other deep limestones, and draws the conclusion that the alkali salts present come from the chalk itself and not from percolation. In covered deposits where no natural drainage is possible, the chalk is found to contain soluble salts, distinct traces of sodium carbonate, chlorid and sulfate being found in chalk beneath London at a depth of 500 and 800 feet.

J. L. H.

#### RECENT ZOOPALEONTOLOGY.

FRITSCH'S 'FAUNA DER GASKOHLE UND DER KALKSTEINE DER PERMFORMATION, BÖMENS.'

DR. ANTOINE FRITSCH, of Prag, has recently issued a complete list of his publications extending back to the year 1851 and covering essentially the broad field of his zoological and paleontological observations. His most monumental work is on the primitive fishes, amphibians and reptiles of the Permian period described in a series of monographs under the title cited above, beginning in the year 1880.

The first monograph covers the long-bodied stegocephalian amphibians of the order Aistopoda; this was continued with the description of the short-bodied forms resembling the modern perennibranchiates in 1884. More advanced labyrinthodonts were described in 1885, the amphibian division of the fauna being concluded in 1887.

The second volume is mainly devoted to the lung fishes, or Dipnoi, and to the more primitive types of selachians. Most important of these types is the genus *Pleuracanthus* which bridges over the gap in fin-structure between the American genus *Cladoselache*, as described by Newberry and Dean, and the fin of the modern shark. This transition form completely disestablished the archipteryial theory of Gegenbaur and established the fin-fold theory of Thacher and Balfour. The other primitive selachians were concluded in 1893, and the great modern actinopterygian types corresponding to Agassiz's ganoids were covered in the parts which appeared during the succeeding two years.

The fourth volume, of which three parts have appeared between 1899 and the present time, is devoted to the insects of the Permian period, especially the myriopods and arachnoids. Finally, this monographic series is brought to a close in 1901 by the third part of the fourth volume which covers the crustaceans and molluscs. This series of monographs will constitute the greatest monument to its author. Also, those who visit Prag find there to their surprise that this Bohemian city contains one of the most beautiful zoological museums in the world, developed under the direction of this veteran zoologist.

H. F. O.

#### GRAVITY ON THE OCEAN.

THE proceedings of the Academy of Sciences of Berlin of February 13, 1902, contain a paper by Professor F. R. Helmert on Dr. Hecker's determination of gravity on the Atlantic Ocean. In July and August, 1901, the International Geodetic Association entrusted Dr. Hecker, of the Potsdam Geodetic Institute, with the duty of making relative gravity observations on the Atlantic Ocean on a voyage between Hamburg and Bahia. The method employed was to determine the pressure of the atmosphere by means of a barometer and a hypsometer (boiling point thermometer). The barometric formula contains a term depending on the intensity of gravity at the place where the observation was made. The hypsometer is independent of this influ-

ence. The comparison of the results of the two methods affords a means of determining relative gravity with more or less accuracy. The results given are preliminary, but, according to Dr. Helmert, they are sufficient to indicate that gravity on the ocean where its depth is profound, between Lisbon and Bahia, is nearly normal. Dr. Helmert states that they furnish splendid confirmation of the hypothesis of Pratt in regard to the isostatic arrangement of the masses of the earth's crust. He states that taken in connection with the results of Nansen's pendulum observations on his North Polar Expedition this hypothesis, from now on, may be reckoned with as a fact at least in the sense of its being a general rule, and he believes that the radial anomalies of the geoid in comparison with the mean ellipsoid will probably not exceed the limits of  $\pm 100$  meters previously suggested by him.

O. H. T.

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*BRYAN DONKIN.*

THE English journals announce the death of Mr. Bryan Donkin, a distinguished engineer and man of science to whom much credit is due for extensive and valuable work in the application of scientific methods in the development of the theory and the art of heat-engine design and construction. His research work has been extensive and continuous and his field of work, applied thermodynamics, mainly, afforded full play for all his energies.

Mr. Donkin was born in 1835, coming of a distinguished family of whom his father, John Bryan, his grandfather, Bryan Donkin, and the physician, Dr. Horatio Bryan Donkin, were famous members. He was educated at the University College of London and at the *École Centrale des Arts et Métiers*, in Paris, and later served an apprenticeship in the workshops of his uncle, at Bermondsey. He then went into business and was sent abroad to erect engines and the heavy machinery of paper-mills, and similar construction. He spent much time in Russia.

He was a partner in 1868 and the chairman of the corporation in 1889. About 1870, he became interested in the then rare opportunities of scientifically investigating the efficien-

cies of the heat-engines and presently made himself one of the leaders in promoting the modern scientific method in engineering and in researches relating to the subject. His influence in the promotion of the movement was exceedingly great and correspondingly useful. He was probably the first to make a complete balance-sheet exhibiting the receipts and expenditures of energy, in the operation of the steam-engine, in such manner as to reveal precisely the extent and the method of distribution of the stream of energy entering the system, its separation into the various currents flowing through the engine and its final disposition as useful and as wasted energy, and the resultant efficiency of the system.

He studied the effects of 'cylinder condensation' and of the two correctives of that serious form of wasted energy, superheating and steam-jacketing, and invented the 'revealer' to reveal the then mysterious changes occurring in the interior of the engine-cylinder. He established many important facts and laws of thermodynamic operations and thermal action, and was a very earnest advocate of all really sound movements in the direction of economic progress.

He wrote extensively on the subject which came to be his specialty and some of his papers are regarded as among the classics of that department of literature. He published a treatise on gas-engines which has now gone to a third edition and translated Diesel's 'Theory and Construction of the Rational Heat-Motor,' and, in 1898, issued a treatise on the steam-boiler. He was familiar with the French as with the German, and spent much time on the continent, studying the latest developments in his field, in all countries.

He was a vice-president of the British Institution of Mechanical Engineers, Watt medalist, Telford and Manby premium and prizeman of the Institution of Civil Engineers, a member of the Royal Institution and of a number of European associations and also of the American Society of Mechanical Engineers.

Mr. Donkin was famous for important and admirable professional work, both in construction and in research, was known in all